Comment on hess-2022-62

Anonymous Referee #1

Referee comment on "Leveraging sap flow data in a catchment-scale hybrid model to improve soil moisture and transpiration estimates" by Ralf Loritz et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-62-RC1, 2022

This manuscript details a study that makes use of sap flow measurements in a catchment-scale model, through the canopy resistance parametrization.

This is an interesting topic since (i) sap flow measurements are not common, particularly at the catchment-scale and probably as a consequence, (ii) the current parametrizations of the transpiration process in hydrological models are poorly constrained.

The paper is well written, the objectives are clearly stated and the results are nicely presented. I have only minor comments concerning mainly the metrics used to assess the differences of the model outputs, the conclusion on machine learning modeling that is in my opinion over-optimistic, and some methodological details that are not detailed enough.

l.83-84: why not use the Machine Learning (ML) model on conductance estimates instead of sap flow data? Could this improve the ability of the ML model to reproduce gc_sap ?

l.160: what is the spatial resolution of the LAI estimates? How many tiles are considered in the catchment?

l.161-162: The term "reference model" for the simulation using the Jarvis-Stewart model could be changed since it may suggest that this simulation is the closest to reality.

l.188-190: There are missing details here. Why is it necessary to fill the gap in canopy conductance estimates? Why not just drop the concerned time steps? Why is it necessary to smooth the time series with a three-hour window? Since no details are provided, the reader cannot figure out if these choices were a priori or a posteriori choices. Anyway, a justification is needed here.

l.196: Similar to the previous comment, why use a sequence length of 96 hours preceding the prediction time step. Was this value optimized or chosen a priori?

l.225-227: I found the description of the results very incomplete. Canopy conductances estimated by sap flow and Jarvis-Stewart are also very different in terms of variability since gc_sap presents much higher temporal fluctuations. The discussion focuses on bias and Spearman correlation but I think that alternative metrics might be used to provide a complete figure of the differences. Please consider using the Pearson correlation coefficient and the ratio of variance, and/or the KGE.

Figure 1: This would be nice to add the streamflow time series since this is the only integrative measurement available. Also, a map showing the location of the available measurements of the catchment would help the reader to figure out whether the soil moisture probes are representative of the catchment. This could also be discussed in analyzing the results of Figure 1. I do not understand why transpiration rates are plotted only at the monthly time scale. Showing the high-frequency values would be valuable. Does the transpiration rate from sap flow are much more temporally variable compared to the simulated transpiration rate from the Jarvis-Stewart model? Is this why the conductance time series were smoothed by the 3-hour rolling mean?

l.247: "The Weierbach fell dry on 61 days (> 0.001 mm h-1) during the three-year record." I did not understand this sentence.

l.264-265: I had an opposite interpretation of the outcome of adding 15 randomly picked days of the dry period. To me, this is proof of the lack of robustness of the ML model and proof of its inability to extrapolate.

l.310-320: In line with my previous comment, I found that the statements expressed in this paragraph are biased in favor of the ML model. I am not a great defender of complex and heavily parameterized models but in my opinion, ML models are also "complex and uncertain" and they suffer from overparametrization.

l.324-326: I think that this sentence should be placed in methodology to help understand why the ML model is used to estimate transpiration and not canopy conductance.

l.358: approach . -> approach.